Compendium of Measures To Prevent Disease and Injury associated with Animals in Public Settings, 2003

National Association of State Public Health Veterinarians (NASPHV)

Summary

Public health officials are increasingly recognizing the risks of infectious disease, human injury, and allergic reaction associated with animals in public settings. In the past decade, outbreaks of zoonotic diseases have occurred at animal exhibits in the United States and other countries. Examples of such outbreaks include *Escherichia coli* O157 among schoolchildren following visits to farms and petting zoos, salmonellosis in children who attended a reptile exhibit, *Coxiella burnetii* infections of patrons to shopping malls, *Mycobacterium tuberculosis* in zoo elephant handlers, and ringworm in persons showing lambs. The risk of zoonotic disease increases when large numbers of persons come into contact with animals. Venues of concern include petting zoos, zoologic institutions, nature parks, circuses, farm tours, livestock birthing exhibits, county or state fairs, schools, and wildlife photo opportunities. Rabid or potentially rabid animals at county fairs, petting zoos, and other public settings have necessitated large numbers of exposure investigations and rabies prophylaxes. In addition to the human health burden, such outbreaks consume significant public health resources. This Compendium provides standardized procedures for public health officials, health care providers, veterinarians, animal exhibitors, and others to reduce the risk of disease transmission and injuries, including allergic reactions.

THE NASPHV COMMITTEE

Millicent Eidson, MA**,** DVM, DACVPM (Epidemiology), CoChair
Jeffrey B. Bender, DVM, MS, DACVPM, CoChair
Russell W. Currier, DVM, MPH, DACVPM
John Grendon, DVM, MPH
Michele Jay-Russell, DVM, MPVM, DACVPM
James J. Kazmierczak, DVM, MS

CONSULTANTS TO THE COMMITTEE

Fredrick J. Angulo, DVM, PhD, DACVPM (Epidemiology), Centers for Disease Control and Prevention (CDC)
John S. Marr, MD, MPH, FACP, Council of State and Territorial Epidemiologists (CSTE)
James H. Wright, DVM, MPVM, DACVPM (Epidemiology), AVMA Council on Public Health and Regulatory Veterinary Medicine

Address all correspondence to:
Jeffrey B. Bender, DVM, MS, DACVPM, Veterinary Public Health, University of Minnesota, 1354 Eckles Ave., 136F ABLMS Bldg., St. Paul, Minnesota 55108.

Compendium of Measures To Prevent Disease and Injury associated with Animals in Public Settings, 2003

National Association of State Public Health Veterinarians (NASPHV)

INTRODUCTION

Contact with animals in public settings, such as petting zoos, fairs, and exhibitions, provides opportunities for entertainment and education about animals and animal husbandry. However, inadequate understanding of disease transmission and animal behavior can lead to illness or injury in attendees, especially children, in these settings. Many diseases can be transmitted from animals to humans (termed "zoonoses"). Of particular concern are situations in which large numbers are exposed and/or become ill, necessitating public health investigation and medical follow-up. A recent review identified over 25 human disease outbreaks associated with visitors to animal exhibition settings.[1] In addition, animal contact can result in serious injuries and allergic reactions. While not intending to discourage contact with animals in public settings, the recommendations in this Compendium provide standardized procedures for minimizing disease and injury risks from animal contacts.

Local and state public health, agriculture, environmental, and wildlife agencies are urged to use these recommendations in establishing their own guidelines or regulations for contacts with animals in public settings. Those responsible for venues which promote contact with animals in public settings, such as petting zoos, zoologic institutions, nature parks, circuses, farm tours, livestock birthing exhibits, county or state fairs, schools, and wildlife photo opportunities, are encouraged to use these recommendations to reduce risk and liability from animal contacts. Methods to reduce risks from contact with animals in health-care facilities[2] and service animals have been developed,[3] and similar recommendations are being developed for pet-assisted therapy. Neither of these types of contact is specifically addressed in this Compendium, although the general principles and recommendations may be applicable in these settings.

PART I. ENTERIC DISEASES

Enteric diseases pose one of the greatest risks from animal contact settings. A number of enteric bacteria and parasites are zoonotic and therefore can be spread from animals to humans. Although most human enteric diseases are transmitted through contaminated food and water, there is increasing evidence that transmission also occurs from contact with animals or their environment. Prior to 1990, few of the reported enteric disease outbreaks were associated with animal contact settings. Recently, however, there have been a number of reported outbreaks among visitors to petting zoos and farms. Organisms linked to human disease outbreaks due to animal contact in animal exhibition settings included *Escherichia coli* O157, *Campylobacter* spp., *Salmonella*, and *Cryptosporidium parvum.* [4-12] Although these reports usually document cattle, sheep, and goats as sources for infection, pets, wildlife, and exotic animals should not be overlooked as potential sources of enteric infections.

The primary mode of transmission for enteric diseases is the fecal/oral route. Since animal fur, hair, or skin can become contaminated with feces, transmission may occur when animals are petted or touched. Transmission can also occur from fecal contamination of foods (including raw milk[13-15] and 'sticky' foods such as cotton candy[16]) water,[17-19] and environmental surfaces.[7,20]

Many animals harbor enteric pathogens. Elimination from animal reservoirs is difficult for several reasons. Organisms such as *E. coli* O157 or *Salmonella* often produce no signs of illness in animals. Additionally, infected animals shed the pathogens intermittently. Thus, while removing sick animals (especially those with diarrhea) is necessary to protect animal and human health, it is not sufficient--animals that appear healthy may still be infectious and contaminate the environment. The long survival of some organisms in the environment also complicates elimination.[21-25] Because of the intermittent shedding and limitations of current laboratory tests, culturing fecal specimens or other attempts to

identify, screen, and remove infected animals may not be effective in eliminating transmission risk. Nor can antimicrobial agents be depended upon to eliminate infection and shedding of enteric pathogens. For these reasons, all animals (livestock, pets, and wildlife) should be considered as potential shedders of enteric pathogens.

Several factors increase the likelihood of enteric pathogen transmission at animal exhibits. Animals at exhibits may be more likely to shed enteric pathogens because of stress induced by prolonged transportation, confinement, crowding, and increased contact with people.[26] Commingling of animals increases the probability that an animal shedding organisms will infect other animals. The prevalence of some enteric pathogens may be higher in immature animals[27-29] and most petting zoos exhibit young animals. Shedding of *E. coli* O157 is highest in the summer and fall when many petting zoos, traveling animal exhibits, and agricultural fairs are scheduled.[30]

In addition to the animal factors listed above, there are a number of other factors that may be associated with illness in people who visit animal exhibits. Some of these factors may include temporary food service facilities, contaminated, overtaxed, or poorly maintained drinking water systems[18,19,31] and waste disposal systems, a preponderance of young children among attendees, hand to mouth activities (e.g. smoking, eating, and thumb-sucking) in proximity to animals, limited handwashing facilities and poor handwashing technique, a lack of supervision of children, popularity of these venues (large numbers of persons), low infectious dose of some enteric pathogens, and a lack of education or awareness of the risk. Studies have documented that farm visitors have a higher risk of illness compared to farm residents.[32,33] Some have speculated that these risks are related to acquired immunity of farm residents, because farm residents are likely exposed frequently at an earlier age.[34]

Lessons from Recent Outbreaks

Two recent *E. coli* O157 outbreaks at farms in Pennsylvania and Washington states were reported by the Centers for Disease Control and Prevention (CDC).[9,11] In that report, CDC provided recommendations for enteric disease prevention in such settings.[11]

In the Pennsylvania outbreak, 51 human cases were identified with illness within 10 days of visiting a dairy farm. The median age of patients was 4 years. Sixteen patients (31%) were hospitalized and eight (16%) developed the hemolytic-uremic syndrome (HUS), a potentially fatal sequela from *E. coli* O157 infection. Patients were more likely to have had contact with cattle, especially calves, or manure. Other activities associated with infection included hand-mouth contact, such as nail biting, and purchasing food from an outdoor concession. Those individuals who washed their hands before eating or after touching animals were less likely to become ill. *E. coli* O157 was isolated from 28 (13%) of the 216 cattle; these isolates had the same molecular fingerprint (pulsed-field gel electrophoresis, PFGE) as the organisms from the human patients. This strain was also isolated from the farm environment. More than 75,000 people, mostly children, visited the farm on the days associated with transmission, and an estimated 7,000 subsequently developed diarrhea. An assessment of the farm environment found that there were no areas for eating and drinking separate from the animal contact areas. In addition, handwashing facilities were limited, not configured for children, and children were unsupervised.[9]

In the Washington outbreak, five persons (median age 7 years) were culture-confirmed with *E. coli* O157 infection and one developed HUS. Three patients were hospitalized. Illnesses were linked to a farm visit where children were allowed to handle a calf, young poultry, rabbits, and goats through a fence. Children brought their own lunches and ate close to the animal pens. Approximately 300 persons visited the farm on the days associated with transmission. Visitors had been advised to bring antibacterial wipes, but no signs were posted advising handwashing, nor were there any handwashing facilities other than a communal rinse basin.[11] The Pennsylvania and Washington outbreaks document a common theme of inadequate handwashing facilities at animal exhibit settings visited primarily by children.

The importance of handwashing is further highlighted by an outbreak of *Salmonella enterica* serotype Enteritidis among visitors to a Colorado zoo reptile exhibit.[7] In January 1996, public health officials noted an increase in *S.* Enteritidis among children; an investigation identified 65 patients. Investigators found that illness was associated with touching a wooden barrier around the Komodo dragon exhibit. Well children were more likely to have washed their hands after visiting the exhibit. *S.* Enteritidis was isolated from patients, a Komodo dragon, and the barriers.

Enteric pathogens can contaminate and persist in animal housing areas. It has been documented that *E. coli* O157 can survive in soil for over 3 month.[21,23] Environmental persistence was recently highlighted by an outbreak in Ohio where 23 patients had attended events in a specified building on the county fairgrounds. Risk factors for infection included: attending a dance in the animal show ring during a fair, eating or drinking in the show ring building, or handling sawdust from the floor. *E. coli* O157 was recovered from numerous environmental sources and continued to be recovered from sawdust on the building floor 42 weeks after the fair ended (J. Varma, personal communication).

Sporadic Infections

The risk of enteric disease transmission is also illustrated by a large number of sporadic infections not attributed to recognized outbreaks. A study of sporadic *E. coli* O157 infections among selected U.S. states and counties in 1996 and 1997 found that 8% of patients six years old or older had visited a farm with cows during the week prior to becoming ill, compared to 1% of the general population.[32] A similar study in England found an association between *E. coli* O157 infection and visiting a farm environment.[35] Epidemiologic studies of human cryptosporidiosis have documented contact with cattle or visiting farms as risk factors for infection.[33,36] Furthermore, a recent FoodNet study of campylobacteriosis attributed *campylobacter* infections to raw milk consumption (4.3%) or contact with farm animals (2.0%).[37]

PART II. INJURIES/RABIES

Injuries associated with animals in public settings may include bites, kicks, scratches, stings, crushing of the hands or feet, and getting pinned between the animal and a fixed object. These injuries have been associated with a number of species including big cats, monkeys, domestic animals, and zoo animals. The settings have included public stables, petting zoos, traveling photo opportunities, schools, children's parties, and camel rides (M. Eidson, J. Bender, M. Jay-Russell, G. Swinger, personal communication).

Injuries from mammals may expose persons to rabies, through contact of potentially infected saliva or nervous tissue in bites, scratches, or other wounds. Persons may also be exposed to rabies if saliva or nervous tissue contact mucous membranes. Although no human rabies deaths have been recorded due to animal contact in organized public settings, a large number of rabies exposures have occurred, requiring extensive public health investigation and medical follow-up. An estimated 665 persons received rabies post-exposure prophylaxis (PEP) after handling a rabid kitten in a public display area in a New Hampshire pet store in 1994.[38] In New York State, 465 persons who attended a county fair in 1996 received PEP because of contact with a rabid goat.[39] In Wyoming incidents, 12 persons in contact with a rabid pony at a rodeo and 40 persons in contact with a rabid dog (brought in for 'show and tell') at a school received PEP (K. Orloski, personal communication). After a bear from a petting zoo died with neurologic signs in Iowa, an estimated 400 people from 10 states required follow-up (with 150 receiving PEP) after contacts such as feeding the bear, wrestling with it, and being nipped by it.[40,41] (Although initial laboratory tests indicating the bear was rabid, final test results did not find evidence of rabies.)[41]

PART III. OTHER DISEASES

Skin contact with animals in public settings may result in human infection. Fifteen cases of ringworm (or 'club lamb fungus') caused by *Trichophyton* spp. and *Microsporum gypseum* were documented among owners and family members who showed lambs during the lamb show season in Georgia.[42] Ringworm infection in 23 people and multiple animal species were traced to a *Microsporum canis* infection in a hand-reared zoo tiger cub.[43] Orf virus infections (contagious ecthyma or 'sore mouth') have occurred in goats and sheep at a children's petting zoo[44] and in persons having contact with an infected lamb at Easter photo opportunities (M. Eidson, personal communication). A zoo attendant, subsequent to handling various species of infected exotic animals, developed an extensive papular skin rash from a cowpox-like virus.[45]

Twelve circus elephant handlers at an exotic animal farm in Illinois were found to be infected with *Mycobacterium tuberculosis* after three elephants died of *M. tuberculosis* disease. One handler had signs consistent with active tuberculosis.[46] Although humans can be a source of infection for elephants, medical history and testing of the handlers indicated that the elephants had been a likely source of exposure for most of the human infections in this instance. In a Louisiana incident, seven animal handlers at a zoo who were previously negative for tuberculosis tested positive after an *M. bovis* outbreak in rhinoceroses and monkeys.[47] Concerns about risk of exposure to the public led to development of USDA guidelines about removal of infected animals from public contact.[48]

Some monkey species used as pets or in public exhibitions (especially macaques) are frequently infected with Herpes B, either asymptomatically or with mild oral lesions. However, human exposure by bites or through fluids can result in a fatal meningoencephalitis.[49,50] Due to difficulties with laboratory testing to confirm monkey infection and high Herpes B prevalence, monkey bites can require intensive public health and medical follow-up.

Zoonotic pathogens may be transmitted by direct or indirect contact with reproductive fluids, aborted fetuses, or newborns from infected dams. Live birthing exhibits, usually involving livestock such as cattle, pigs, goats, or sheep, are becoming increasingly popular at agricultural fairs. Although the public usually does not have direct contact with the animal during birthing, newborns and their dams are usually available for petting and observation afterward. Q fever, leptospirosis, and brucellosis are potentially serious zoonoses that may be associated with contact with reproductive materials.

Q fever (*Coxiella burnetii*) is a rickettsial disease that most commonly infects cattle, sheep, and goat reservoirs. Q fever sometimes causes abortion in animals, but more often the infection is asymptomatic. During parturition, the organism may be shed in high numbers and become aerosolized. Most people exposed to Q fever develop an asymptomatic infection, but clinical illness can range from an acute influenza-like illness to life-threatening endocarditis. A large Q fever outbreak involving 95 confirmed cases and 41 hospitalizations was linked to goats and sheep giving birth at petting zoos. Notably, the petting zoos were in indoor shopping malls, suggesting that birthing exhibits in closed spaces may be an important factor in Q fever transmission.[51]

Animal chlamydial infections may also result in reproductive problems in exposed persons.[52] *Chlamydophila psittaci* infection resulted in an ornithosis (pneumonia) outbreak among the staff at the Copenhagen Zoo.[53]

Ecto- and endo-parasites pose some concern where humans and exhibit-animals interact. Many authorities view Sarcoptes scabiei, a skin parasite, as one species with multiple varieties that infect humans and specific animals including swine, dogs, cats, foxes, cattle, and coyotes. Even though human infestation from animal sources is usually self-limiting, a pruritic skin condition may occur for several days and be difficult to diagnose. Animal fleas in certain settings also may contact people, occasionally bite, and increase risk of infection or allergic reaction. Fleas also serve as the intermediate host for one tapeworm species that could colonize children. Numerous other animal helminthes may infect humans fecal/orally or through contact with animals or contaminated earth. Parasite control through veterinary care and sound husbandry coupled with hand washing should reduce risk of exposures.

PART IV. ALLERGY/ASTHMA

Asthma is a serious public health problem affecting people of all ages, races and ethnic groups. In the United States, an estimated 14.9 million people have asthma and 5,000 deaths occur each year due to asthma. Asthma and allergies are exaggerated reactions of the body's immune system to proteins also known as allergens. Inhalation is one of the most common ways for allergens to enter the body.

Although there are many types of proteins that induce allergic reactions, some are associated with animals: dander, scales, fur, feathers, body wastes (urine), and saliva.[54,55] Such allergies are common; allergies induced by dog and cat contact are estimated to occur in approximately 15% of the population.[56] In addition, dust and feed accumulations in animal areas attract and absorb moisture that can create an environment for the growth of allergenic molds and other microorganisms.

Venues with animals, particularly those in which animals normally are not found (e.g. schools, childcare centers, non-animal related businesses), should recognize the potential threat that animals can pose to people with allergies and/or asthma. In addition, it is the responsibility of those with known allergies to animals to avoid common animal settings.

PART V. RECOMMENDATIONS

A survey of state and territorial public health departments in 2000 identified no state laws to control exposure of humans to enteric pathogens at venues where the public has access to farm animals.[11] A more recent survey[1] found that only Massachusetts,[57] Ohio, and Washington[58] had developed specific guidelines for petting zoo exhibitors and other animal exhibition venues. A new law to regulate sanitation at Pennsylvania animal exhibitions was recently enacted.[59]

Recommendations to prevent enteric infections at animal exhibitions and agricultural fairs were developed in the United Kingdom in 1989,[60] 1995,[61] and 2000.[62] In the U.S., the American Zoo and Aquarium Association (AZA) developed guidelines and standards for AZA accredited institutions to reduce risks associated with public contact in zoologic parks.[63] In accordance with the Animal Welfare Act, the United States Department of Agriculture's (USDA) Animal Care licenses and inspects certain animal exhibits for humane treatment of animals, but these regulations are not intended for human health protection.[64] There are no federal laws to address the risk for transmission of pathogens at venues where the public has contact with animals, but guidelines to reduce the risk of enteric pathogens were issued by the Centers for Disease Control and Prevention (CDC) in 2001.[11] CDC also issued recommendations for preventing transmission of *Salmonella* from reptiles to humans.[65] Guidelines have been developed by the Association for Professionals in Infection Control and Epidemiology (APIC) to address risks associated with the use of service animals in health care settings.[3]

The guidelines above contributed to the recommendations in this Compendium. Although there are a wide variety of animal contact settings, application of the Compendium will help to reduce disease and injury risk. Implementation will need to be tailored to the specific venue. The Compendium should be incorporated into guidelines or regulations developed at the state or local level, and should be disseminated to persons who own or manage animals in public settings. Incidents of disease transmission or injury should be promptly reported to public health authorities and investigated.

Recommendations for Education

Education is essential to reduce risks associated with animal contact in public settings. The public must be educated so they can weigh the benefits and risks of animal contact. Animal owners, exhibit operators, and their staff must be informed to make appropriate management decisions. Specific recommendations for education include:

- **Provide Educational Materials**: Include information about the risks of enteric diseases, injuries, rabies, and other diseases, and ways to reduce risks. Include information about which animals pose a greater risk of disease transmission or injury, and which people are at increased risk of serious infections. Materials should be age- and language-appropriate. Provide the messages in multiple formats, such as signs, handouts, brochures, etc.
- **Provide Education Prior to Contact**: When possible, information should be provided before the animal contacts. For example, recommendations should be provided in information sent to fair exhibitors, those arranging school field trips and classroom exhibits, and persons receiving animal exhibition or education licenses.

- **Train Staff**: Staff at animal contact venues should be trained in reducing the risk of disease and injury associated with animals, and in measures to comply with local and state guidelines about reporting of animal bites, scratches, or other injuries resulting from animal contact.

Recommendations for Controlling Public Contact with Animals

Animal contacts with the public should occur in controlled settings. Such controls will reduce the types of contacts that may lead to injuries or disease, or if such contacts occur, the exposures are likely to be reported, documented, and handled appropriately to reduce further risk. Control methods should include:

- **Venue Design**: Physical design of contact venues should minimize risk and facilitate hand-washing. At a minimum, venues should designate separate animal areas and non-animal areas, with different guidelines for each. Some jurisdictions may wish to have more restrictive recommendations in areas where animal contact is specifically encouraged (such as petting zoos). Design requirements may include double barriers to prevent hand contact with animals or contaminated surfaces other than in specified interaction areas. Consideration should be given to manure disposal and waste water runoff, in relation to pedestrian traffic.
- **Non-animal Areas**: With the exception of service animals, animals should not be allowed in non-animal areas. Food and drink should only be prepared, served, and consumed in designated non-animal areas.
- **Milk Consumption**: Attendees should not drink unpasteurized, raw milk (including milk from the bulk tank).
- **Drinking Water**: Local public health authorities should inspect drinking water systems prior to use. Only potable water should be used for human consumption. Back-flow prevention devices should be installed between outlets in livestock areas and water lines supplying other uses on the grounds. If the water supply is from a well, adequate distance must be maintained from possible sources of contamination such as animal holding areas, manure piles, etc. Clear maps of the water distribution system should be available to use in identifying potential or actual problems. Minimize the use of outdoor hoses, and do not leave hoses on the ground. Do not allow visitors to drink from hoses, and mark those used for watering animals and cleaning animal areas as "not for human consumption" because of the potential for contamination.
- **Animal Births**: If animal births occur, ensure that the public has absolutely no contact with animal birthing products. The environment must be thoroughly cleaned after each birth and all waste products appropriately discarded. Animal birthing areas should be well ventilated and not placed in closed settings.

Recommendations for Management of Activities In Animal Areas:

In certain types of venues, for example, petting zoos, public contact with animals will be encouraged. In these settings, extra precautions should be taken to reduce the risk of injuries and disease transmission.

- **Food and Beverages**: Food and beverages should not be prepared, served, or consumed in animal areas. In addition, smoking, carrying toys, and use of pacifiers and baby bottles should not be permitted in animal areas.
- **Handwashing**: Hand washing is critical immediately after leaving the animal area, particularly before eating. See Appendix A for detailed recommendations for handwashing.
- **Cleaning and Disinfection**: Manure should be cleaned up and disposed promptly in animal areas. Cleaning and disinfection is essential when animal areas are converted to non-animal areas, such as public events (i.e. weddings, dances, etc.). It is important to remove organic material (bedding material, feed, and manure) before using disinfectants. A list of disinfectants is provided in Appendix B.
- **Adult Supervision of Children**: For children aged < 5 years, their animal contacts should be carefully supervised by adults to discourage hand to mouth contact and to insure appropriate hand washing when needed.

- **Venue Staff**: Staff must be present in areas of animal contact to encourage appropriate human animal interactions, to reduce risk (e.g. by promptly cleaning up wastes), and receive reports of injuries and exposure incidents.
- **Feeding Animals**: If feeding animals is permitted, only food sold by the venue for that purpose should be allowed. Food should not be fed to animals in containers that can be eaten by people (for example, ice cream cones or other edible products) to reduce the risk of animal bites and the likelihood of children eating food that has come into contact with animals.
- **Logs or Registers**: In selected settings, i.e. where contacts with higher risk animals (see below) are permitted, a sign-in register sheet with names, addresses, and phone numbers may be considered at the discretion of the local health department or exhibit operator.

Recommendations for Management of Animals in Animal Areas

The risk of disease or injuries from animal contacts can be reduced by carefully managing the specific animals used for such contacts. Considerations for management of animals in contact with the public should include:

- **Animal Care**: Animals should be monitored daily by the owners or caretakers for any signs of illness, and receive veterinary care if signs of illness occur. No ill animals or animals from herds with recent abortions should be on exhibit. Animals should be housed to minimize animal stress and overcrowding, which can increase shedding of microorganisms. If feasible in areas with high rabies incidence, animals should also be housed to reduce potential exposures from wild animal reservoirs.
- **Veterinary Care**: Owners should retain and utilize the services of a licensed veterinarian. Vaccination, preventive care, and parasite control appropriate to the species should be provided. Screening for some specific diseases should be considered such as tuberculosis (elephants,[48] primates) and Q fever (ruminants in birthing exhibits).[66]
- **Rabies:** Mammals used in venues where contact is encouraged, such as petting zoos should be current on rabies immunizations.[67] For previously unvaccinated mammals, vaccinate at least 3 months prior to public contact. In high incidence areas, it is particularly critical that all mammals in situations where public contact could occur (e.g. fairs) be current on rabies immunization. If there is no licensed rabies vaccine for a particular species used in a public contact setting, licensed rabies vaccines may be used by veterinarians 'off-label'. This use will not provide the same level of assurance as vaccination of a species with a licensed vaccine, but may decrease the probability of rabies and rabies exposures. Mammals that are too young to be immunized, or too young to allow vaccination before use in a public contact setting, should be used only if additional restrictive measures are available to reduce and manage risks.
- **Dangerous Animals**: Some animals are not appropriate in exhibit settings where there is a possibility of animal contact. These include rabies reservoir species such as bats, raccoons, skunks, foxes, and coyotes, and animals likely to cause serious injury such as monkeys, lions, tigers, wolves/wolf-hybrids, bears, and venomous reptiles.

Recommendations for High-Risk Populations

Groups at high risk for serious infection include children aged < 5 years, the elderly, pregnant women, immunocompromised persons, such as those with HIV/AIDS, those on immunosuppressive therapy, etc. Persons at high risk should observe heightened precautions at any animal exhibit. These precautions may include restriction of animal contact or strict enforcement of risk reduction methods such as handwashing. Such persons should avoid animals at greater risk for transmitting enteric diseases including calves and other young ruminant animals, young poultry, reptiles, amphibians, and ill animals.

PART VI. REFERENCES

1. Bender JB, Shulman SA, 'Animals in Public Contact' subcommittee, National Association of State Public Health Veterinarians. The need for public health guidelines for visitors to animal exhibition settings. *J Am Vet Med Assoc*, in press.
2. Sehulster L, Chinn RYW. Guidelines for environmental infection control in health-care facilities: Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). At: http://www.cdc.gov/ncidod/hip/HICPAC/publications.htm
3. Duncan SL. APIC State-of-the-Art Report: the implications of service animals in health care settings. *Am J Infect Control* 2000;28:170-80.
4. Shukla R, Slack R, George A, et al. *Escherichia coli* O157 infection associated with a farm visitor centre. *Commun Dis Rep CDR Rev* 1995;5:R86-90.
5. Sayers G, Dillon M, Connolly E, et al. Cryptosporidiosis in children who visited an open farm. *Commun Dis Rep CDR Rev* 1996;6:R140-R144.
6. Evans M, Gardner D. Cryptosporidiosis outbreak associated with an educational farm holiday. *Commun Dis Rep CDR Rev* 1996;1996:R50-R51.
7. Friedman CR, Torigian C, Shillam PJ, et al. An outbreak of salmonellosis among children attending a reptile exhibit at a zoo. *J Pediatr* 1998;132:802-7.
8. Pritchard GC, Willshaw GA, Bailey JR, et al. Verocytotoxin-producing *Escherichia coli* O157 on a farm open to the public: outbreak investigation and longitudinal bacteriological study. *Vet Rec* 2000;147:259-64.
9. Crump JA, Sulka AC, Langer AJ, et al. An outbreak of *Escherichia coli* O157:H7 infections among visitors to a dairy farm. *N Engl J Med* 2002;347:555-60.
10. Warshawsky B HB, Gutmanis I et al. An outbreak of *Escherichia coli* O157:H7 related to animal contact at a petting zoo. *Can J Infect Dis* 2002;13:175-81.
11. Outbreaks of *Escherichia coli* O157:H7 infections among children associated with farm visits--Pennsylvania and Washington, 2000. *MMWR Morb Mortal Wkly Rep* 2001;50:293-7.
12. Chapman PA, Cornell J, Green C. Infection with verocytotoxin-producing *Escherichia coli* O157 during a visit to an inner city open farm. *Epidemiol Infect* 2000;125:531-6.
13. Sharp JC. Infections associated with milk and dairy products in Europe and North America, 1980-85. *Bull World Health Organ* 1987;65:397-406.
14. Djuretic T, Wall PG, Nichols G. General outbreaks of infectious intestinal disease associated with milk and dairy products in England and Wales: 1992 to 1996. *Commun Dis Rep CDR Rev* 1997;7:R41-5.
15. Korlath JA, Osterholm MT, Judy LA, et al. A point-source outbreak of campylobacteriosis associated with consumption of raw milk. *J Infect Dis* 1985;152:592-6.
16. Payne CJI, et al. Vero cytotoxin-producing *E. Coli* O157 gastroenteritis in farm visitors, North Wales. *Emerg Inf Dis* 2003;9:526-30.
17. Waterborne outbreak of gastroenteritis associated with a contaminated municipal water supply, Walkerton, Ontario, May-June 2000. *Can Commun Dis Rep* 2000;26:170-3.
18. Bopp DJ, Sauders BD, Waring AL, et al. Detection, isolation, and molecular subtyping of *Escherichia coli* O157:H7 and *Campylobacter jejuni* associated with a large waterborne outbreak. *J Clin Microbiol* 2003;41:174-80.
19. Outbreak of *Escherichia coli* O157:H7 and *Campylobacter* among attendees of the Washington County Fair—New York, 1999. *MMWR Morb Mortal Wkly Rep* 1999;48:803-5.
20. Croft DR AJ, Robert C. Johnson R, Monson T, Lucas D, Kurzynski T, Hoang-Johnson D, Machmueller L, Kelly L, Crossfield D, Rosariao G, Kaspar C. Outbreaks of *Escherichia coli* O157:H7 infections associated with a pancake breakfast served in a stock pavilion with contaminated livestock bedding-Wisconsin, 2001. *EIS Conference, Atlanta, GA* 2002.
21. Kudva IT, Blanch K, Hovde CJ. Analysis of *Escherichia coli* O157:H7 survival in ovine or bovine manure and manure slurry. *Appl Environ Microbiol* 1998;64:3166-74.
22. LeJeune JT, Besser TE, Hancock DD. Cattle water troughs as reservoirs of *Escherichia coli* O157. *Appl Environ Microbiol* 2001;67:3053-7.
23. Maule A. Survival of verocytotoxigenic *Escherichia coli* O157 in soil, water and on surfaces. *Symp Ser Soc Appl Microbiol* 2000;29:71S-78S.
24. Randall LP, Wray C, Davies RH. Survival of verocytotoxin-producing *Escherichia coli* O157 under simulated farm conditions. *Vet Rec* 1999;145:500-1.
25. Rahn K, Renwick SA, Johnston RP, et al. Persistence of *Escherichia coli* O157:H7 in dairy cattle and the dairy farm environment. *Epidemiol Infect* 1997;119:251-9.
26. Williams LP, Newell KW. Salmonella excretion in joy-riding pigs. *Am J Pub Hlth* 1970;60:926-9.

27. Castro-Hermida JA, Gonzalez-Losada YA, Ares-Mazas E. Prevalence of and risk factors involved in the spread of neonatal bovine cryptosporidiosis in Galicia (NW Spain). *Vet Parasitol* 2002;106:1-10.
28. Garber LP, Wells SJ, Hancock DD, et al. Risk factors for fecal shedding of *Escherichia coli* O157:H7 in dairy calves. *J Am Vet Med Assoc* 1995;207:46-9.
29. Hancock DD, Besser TE, Kinsel ML, et al. The prevalence of *Escherichia coli* O157.H7 in dairy and beef cattle in Washington State. *Epidemiol Infect* 1994;113:199-207.
30. Hancock DD, Besser TE, Rice DH, et al. A longitudinal study of *Escherichia coli* O157 in fourteen cattle herds. *Epidemiol Infect* 1997;118:193-5.
31. Crump JA, Braden CR, Dey ME, Hoekstra RM, et al. Outbreak of *Escherichia coli* O157 infections at multiple county agricultural fairs: A hazard of mixing cattle, concessions stands, and children. *Epidemiol Infect* 2003;in press.
32. Kassenborg H HC, Evans M, Chin G, Fiorentino T, Vugia D, Bardsley M, Slutsker L, Griffin P. Case-Control Study of Sporadic *Escherichia coli* O157:H7 Infections in 5 FoodNet Sites (Calif., Conn., GA., Minn., Ore.). *1st International Conference on Emerging Infectious Diseases. Atlanta, GA, March 1998.* 1998.
33. Soderlund D SK, Bender J, Hedberg C. An Epidemiologic Investigation of Cryptosporidiosis in Minnesota. *Programs and abstracts of the International Conference on Emerging Infectious Diseases, July 2000, Atlanta, GA*. 2000.
34. Belongia EA, Chyou PH, Greenlee RT, et al. Diarrhea Incidence and Farm-Related Risk Factors for *Escherichia coli* O157:H7 and *Campylobacter jejuni* Antibodies among Rural Children. *J Infect Dis* 2003;187:1460-8.
35. O'Brien SJ, Adak GK, Gilham C. Contact with farming environment as a major risk factor for Shiga toxin (Vero cytotoxin)-producing *Escherichia coli* O157 infection in humans. *Emerg Infect Dis* 2001;7:1049-51.
36. Roy SL DS, Stenzel S, Shiferaw B, Roberts J, Khalakdina A, Marcus R, Nelson R, Segler S, Shah D, Thomas S, Vugia D, Zansky S, Dietz V, Beach M. A case-control study of risk factors for sporadic cryptosporidiosis - United States, 1999-2001. *52nd Annual Epidemic Intelligence Service (EIS) Conference* 2003.
37. Friedman CR HR, Samuel M, Marcus R, Bender JB, Beletshachew S, Reddy S, Desai S, Helfrick DL, Hardnett F, Carter M, Anderson B. Risk Factors for sporadic *Campylobacter* infections in the United States: A case-control study in FoodNet sites. *Clin Inf Dis,* in press.
38. Mass treatment of humans exposed to rabies--New Hampshire, 1994. *MMWR Morb Mortal Wkly Rep* 1995;44:484-6.
39. Chang HG, Eidson M, Noonan-Toly C, et al. Public health impact of reemergence of rabies, New York. *Emerg Infect Dis* 2002;8:909-13.
40. Multiple human exposures to a rabid bear cub at a petting zoo and barnwarming—Iowa, August 1999. *MMWR Morb Mortal Wkly Rep* 1999;48:761.
41. Public health response to a potentially rabid bear cub. *MMWR Morb Mortal Wkly Rep* 1999;48:971-3.
42. Hullinger G, Cole JJ, Elvinger F, et al. Dermatophytosis in show lambs in the United States. *Veterinary Dermatology* 1999;10:73-76.
43. Scott WA. Ringworm outbreak [letter]. *Vet Rec* 1986;118:342.
44. Stover J, Dolensek E, Basford B, et al. Contagious Ecthyma in a Children's Zoo. *J Zoo An Med* 1986;17:115-116.
45. Marennikova SS, Maltseva NN, Korneeva VI, et al. Outbreak of pox disease among carnivora (felidae) and edentata. *J Infect Dis* 1977;135:358-66.
46. Michalak K, Austin C, Diesel S, et al. Mycobacterium tuberculosis infection as a zoonotic disease: transmission between humans and elephants. *Emerg Infect Dis* 1998;4:283-7.
47. Stetter MD, Mikota SK, Gutter AF, et al. Epizootic of Mycobacterium bovis in a zoologic park. *J Am Vet Med Assoc* 1995;207:1618-21.
48. The National Tuberculosis Working Group For Zoo & Wildlife Species. Guidelines For The Control Of Tuberculosis In Elephants, 2003. http://cofcs66.aphis.usda.gov/ac/TBGuidelines2003.html
49. Fatal Cercopithecine herpesvirus 1 (B virus) infection following a mucocutaneous exposure and interim recommendations for worker protection. *MMWR Morb Mortal Wkly Rep* 1998;47:1073-6,1083.
50. Cohen JI, Davenport DS, Stewart JA, et al. Recommendations for prevention of and therapy for exposure to B virus (cercopithecine herpesvirus 1). *Clin Infect Dis* 2002;35:1191-203.
51. Milford F VA, Lambert L, Morin M, Petit G, Trottier J. Large Q-fever outbreak related to exposure to petting zoos in two shopping malls. 51st Annual Conf on Diseases in Nature Transmissible to Man, Texas, USA 2001.
52. Hyde SR, Benirschke K. Gestational psittacosis: case report and literature review. *Mod Pathol* 1997;10:602-7.
53. Christensen AL JJ, S Ingeberg. The risk of ornithosis among the staff of Copenhagen Zoo. *Ugeskr Laeger* 1990;152:818-20.
54. Bardana EJ, Jr. What characterizes allergic asthma? *Ann Allergy* 1992;68:371-3.

55. Lincoln TA, Bolton NE, Garrett AS, Jr. Occupational allergy to animal dander and sera. *J Occup Med* 1974;16:465-9.
56. American Academy of Allergy, Asthma and Immunology. Task Force on Allergic Disorders. Executive Summary Report. 1998.
57. Recommendations for Petting Zoos, Petting Farms, Animal Fairs, and Other Events and Exhibits Where Contact Between Animals and People is Permitted. www.state.ma.us/dph/cdc/epii/rabies/petzoo.htm
58. Washington State Department of Health Office of Environmental Health and Safety. Recommendations to reduce the risk of disease transmission from animals to humans at petting zoos, fairs, and other animal exhibits, 2001. At: www.doh.wa.gov/ehp/ts/Zoo/PettingZooHealthGuide.pdf
59. Pennsylvania Bureau of Animal Health and Diagnostic Services. Act 211 of 2002 -- Animal Exhibition Sanitation or e. Coli Act. At: http://www.agriculture.state.pa.us/animalhealth/lib/animalhealth/sb1325p1990-e.coli._act_211_of_2002.pdf
60. Casemore D. Educational farm visits and associated infection hazards. *Commun Dis Rep* CDR Rev 1989;19:3.
61. Dawson A, Griffin R, Fleetwood A, et al. Farm visits and zoonoses. *Commun Dis Rep* CDR Rev 1995;5:R81-6.
62. Middlesex-London Health Unit Investigation and Recommendations. An *E. coli* O157:H7 outbreak associated with an animal exhibit, 1999. At: www.healthunit.com/reportsresearch.htm
63. American Zoo and Aquarium Association . Guide to accreditation of zoological parks and aquariums, 2003. At: www.aza.org/Accreditation/Documents/AccredGuide.pdf
64. United States Department of Agriculture Animal Care. At: http://www.aphis.usda.gov/ac/
65. Reptile-Associated Salmonellosis, 1996-1998. *MMWR Morb Mortal Wkly Rep* 1999;48:1009-1013, 1051.
66. McQuiston JH, Childs JE. Q fever in humans and animals in the United States. *Vector Borne Zoonotic Dis* 2002;2:179-91.
67. National Association of State Public Health Veterinarians. Compendium of Animal Rabies Prevention and Control, 2003. *MMWR Morb Mortal Wkly Rep 2003*;52 (RR-5):1-6.

Appendix A: Handwashing Recommendations to Reduce Disease Transmission from Animals in Public Settings

Handwashing is the single most important prevention step for reducing disease transmission from animals in public settings.

How to Handwash: Wash hands thoroughly with running water, pump soap into palms, rub together to make a lather, scrub hands vigorously for 15 seconds, rinse soap off of hands, then dry hands with a disposable towel. Young children need assistance in washing hands.

Handwashing Facilities or Stations: Handwashing facilities should be accessible, sufficient for the maximum anticipated attendance, and configured for use by children and adults.

- Communal basins do not constitute adequate handwashing facilities.
- Hand wash stations should be located at the animal area exits and in food concession areas.
- Maintenance should include routine cleaning and restocking of towels and soap.
- Running water should be of sufficient volume and pressure to remove soil from hands. Volume and pressure may be significantly reduced if the water supply is furnished from a holding tank rather than a unit that is connected to a permanent water supply under pressure.
- The design of the hand wash unit should leave the hands free for hand washing.
- If the hand wash stations are supplied with only cold water a soap that emulsifies more easily in cold water should be provided.

Handwashing Agents: Liquid soap dispensed by a hand or foot pump is recommended. Studies in hospitals indicate that alcohol-based hand sanitizers may be effective against some disease agents. However, they may be ineffective if hands are grossly soiled, or against certain organisms.

Signs: Friendly hand wash reminder signs can be posted at exits to animal exhibit areas and petting zoos. Signs should be provided in animal exhibit areas that direct visitors and animal handlers to the location of adjacent hand wash stations. Hand wash signs should be posted at the hand wash stations and at restroom lavatories to ensure proper hand wash practices. The placement of hand wash reminder signs at food concession areas is recommended. An example of a hand-washing sign is:

Hand Washing: How and When	
How: - Wet hands with running water - Pump soap into palms - Rub together to make a lather - Scrub hands vigorously for 15 sec - Rinse soap off of hands - Dry hands	**When:** - After going to the toilet - After petting or handling animals - Before eating - Before preparing foods

Appendix B: Table of Disinfectants and Properties

Local and /or state environmental health officers can provide specific recommendations for appropriate disinfectant selection.

Compound	Chlorine* 0.01-5%	Iodine Iodophor 0.5-5%	Chlorhexidine 0.05-0.5%	Alcohol** 70-95%	Oxidizing 0.2-3%	Phenol 0.2-3%	Quaternary Ammonium 0.1-2%
Examples	Clorox	Tincture/ Provodine	VikronS	Rubbing alcohol	Novalsan	Lysol	Roccal-D
Bactericidal	Good	Good	Very Good	Good	Good	Good	Good
Virucidal	Very Good	Good	Very Good	Good	Good	Fair	Fair
Envelope Viruses	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Non-Envelope Viruses	Yes	Yes	No	No	Yes	No	No
Bacterial Spores	Fair	Fair	Poor	Fair	Fair-Good	Poor	Poor
Fungicidal	Good	Good	Fair to Good	Fair	Fair	Good	Fair
Protozoal Parasites	Fair strong Conc	Poor	Poor	Poor	Poor	Poor	Fair (Ammonia)
Effective in Organic Matter	Poor	Fair	Fair	Fair	Poor	Good	Poor
Inactivated by soap	No	No and Yes	No	No	No	No	Yes
Effective in Hard water	Yes	No	Yes	Yes	Yes	Yes	No
Contact Time (minutes)	5-30	10-30	5-10	10-30	10-30	10-30	10-30
Residual activity	Poor	Poor	Good	Fair	Poor	Poor	Fair

Adapted from Nebraska Cooperative Extension

*Bleach should be diluted to 1:32 and mixed daily or when contaminated with organic matter.
**Rubbing alcohol is flammable.